SUBSTITUTE SPECIFICATION

FLAT PANEL DISPLAY

BACKGROUND OF THE INVENTION

(a) Field of the Invention

The present invention relates to a flat panel display and, more particularly, to a flat panel display which has spacers for maintaining the cell gap in a constant manner.

(b) Description of the Related Art

Generally, flat panel displays (FPDs) have a faceplate, a backplate, and a side wall that are combined together to form a vacuum tight cell. The vacuum degree of the cell is established to be about 10^{-7} torr.

In such a flat panel display, compared to other display devices, it is difficult to constantly maintain the cell gap due to the difference between the internal pressure and the external atmospheric pressure. For this reason, one or more spacers are provided within the cell to maintain the cell gap in a constant manner.

U. S. Patent No. 5,650,690 or 5,543,683 discloses a method of fabricating a field emission display that has a gripper disposed on the faceplate, a Iocator disposed on the backplate, and a spacer wall interposed between the gripper and the Iocator. The spacer wall for securing the internal space of the device is formed with ceramic or glass, and interposed between the faceplate and the backplate via the gripper and the Iocator.

However, in the above structure, the gripper and the Iocator for holding the spacer wall should be separately provided, resulting in increased production cost and complicated processing steps (for example, photolithography for a photosensitive material).

Furthermore, in order to fit the spacer wall between the gripper and the Iocator, each spacer should be inserted into the gripper or the Iocator. This requires elaborate working conditions while making it difficult to maximize work efficiency.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a flat panel display which can mount spacers without separate fixation members.

It is another object of the present invention to provide a flat panel display which can be fabricated in a simplified manner.

These and other objects may be achieved by a flat panel display including a faceplate, and a backplate combined with the faceplate to form a vacuum tight cell. An image production unit is provided within the cell to produce display images from the cell. A plurality of spacers are mounted within the cell such that the spacers are placed at a non-display area. The spacers are held between the faceplate and the backplate. A pair of alignment members are connected to the spacers in a body to align the spacers at the non-display area in a constant manner.

Each alignment member is connected to one-sided end portions of the spacers. A longitudinal axis of each spacer is preferably positioned substantially parallel to a side of the cell.

A pair of subsidiary alignment members may be arranged perpendicular to the alignment members to form a rectangular frame.

Each spacer is provided with a plurality of exhaust grooves. The exhaust grooves are arranged at the spacer in the longitudinal direction while being spaced apart from each other with a predetermined distance.

Each spacer may be further provided with a plurality of grooves for preventing image distortion. The image distortion preventing grooves are arranged at the spacer in the longitudinal direction while being spaced apart from each other with a predetermined distance.

BRIEF DESCRIPTION OF THE DRAWINGS

A more complete appreciation of the invention, and many of the attendant advantages thereof, will be readily apparent as the same becomes better understood by reference to the following detailed description when considered in conjunction with the accompanying drawings in which like reference symbols indicate the same or the similar components, wherein:

Fig. 1 is a cross sectional view of a flat panel display according to a preferred embodiment of the present invention;

Fig. 2 is a perspective view of a spacer structure for the flat panel display shown in Fig. 1; and

Fig. 3 is a perspective view of a spacer structure fixed to a plate for the flat panel display shown in Fig. 1.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Preferred embodiments of this invention will be explained with reference to the accompanying drawings.

Fig. 1 is a cross sectional view of a flat panel display according to a preferred embodiment of the present invention where a field emission display (FED) is exemplified as the flat panel display.

The field emission display includes a faceplate 1, and a backplate 3 spaced apart from the faceplate 1 by with a predetermined distance and positioned while proceeding parallel thereto. The faceplate 1 is combined with the backplate 3 to thereby form a vacuum tight cell.

The faceplate 1 is sequentially overlaid with an anode electrode 1a, and a plurality of phosphor layers 1b placed at an even plane in with a predetermined pattern. A black matrix 1c surrounds the phosphorous layers 1b to improve contrast, the black matrix 1c being and formed with chrome (Cr) or chrome/chrome oxide layer (Cr/CrO_x).

The backplate 3 is overlaid with a plurality of cathode electrodes 3a placed at an even plane in a stripe pattern while facing the anode electrode 1a. A plurality of gate electrodes 3c crosses the cathode electrodes 3a by interposing an insulating layer 3b. The gate electrodes 3c are also formed in with a stripe pattern.

The insulating layer 3b has breakthrough holes 30b at the positions where the cathode electrodes 3a and the gate electrodes 3c cross each other, and the gate electrodes 3c has also opening portions 30c at those positions. A microtip-based field emitter 3d is placed on the cathode electrode 3a within the area of each breakthrough hole 30b.

A plurality of spacers 5 are held between the faceplate 1 and the backplate 3. The spacers 5 are positioned at the non-display area in the cell where light is intercepted by the black matrix 1c.

As shown in Fig. 2, the spacers 5 are positioned parallel to proceed along the short sides of the plates 1 and 3. Of course, the spacers 5 may alternatively be positioned parallel to proceed along the long sides of the plates 1 and 3. A pair of alignment members 7 are integrally provided each at one-sided end portions of the spacers 5 to hold the spacers 5 at the non-display area in a constant manner.

Subsidiary alignment members 9 are integrally provided each at one-sided end portions of the alignment members 7 to further reinforce the holding state of the spacers 5.

That is, the alignment members 7 and the subsidiary alignment members 9 altogether form a rectangular frame, and this frame can serve to maintain the spacers 5 at proper places in a constant manner.

In the field emission display having the above spacer structure, after field emission components are provided between the plates 1 and 3, the plates 1 and 3 are sealed together to form a vacuum tight cell. The vacuum degree of the cell is controlled to be about 10^{-7} torr through exhaustion.

However, in case the exhaustion process is performed in such a state that the spacers 5, the alignment members 7 and the subsidiary alignment members 9 are mounted between the plates 1 and 3 in the longitudinal direction, it is difficult to expect fluent exhaustion due to the spacer components 5, 7 and 9.

Therefore, in this preferred embodiment, a plurality of exhaust grooves 5a are formed at each spacer 5 to realize fluent flowing of exhaust gas within the cell. The exhaust grooves 5a are arranged at the spacer 5 in the longitudinal direction and are positioned adjacent to the backplate 3. The exhaust grooves 5a are spaced apart from each other by a predetermined distance.

Furthermore, a plurality of image distortion preventing grooves 5b are formed at each spacer 5 and are positioned adjacent to the faceplate 1. The image distortion preventing grooves 5b are to reduce the contact area between the spacer 5 and the faceplate 1, thereby minimizing distortion of picture images due to the contact resistance. The image distortion preventing grooves 5b are spaced apart from each other by a predetermined distance in one to one correspondence with the exhaust grooves 5a.

Exhaust grooves 7a and 9a are arranged along the alignment members 7 and the subsidiary alignment members 9, the grooves 7a and 9a being symmetrically positioned adjacent to, respectively,

the faceplate 1 and the backplate 3. The exhaust grooves 7a or 9a are spaced apart from each other by a predetermined distance.

As shown in Fig. 3, in the fabrication process, the spacers 5 are mounted on the backplate 3 while being held by the alignment members 7 and the subsidiary alignment members 9. At this time, the position control of the spacers 5 can be easily performed once for all spacers 5 due to the presence of the frame structure, and, after the mounting, stable positioning thereof can be obtained.

In accordance with the present embodiment of the invention, the spacers 5, the alignment members 7 and the subsidiary alignment members 9 are formed with a photosensitive glass. The photosensitive glass is exposed to light through an appropriately patterned mask, the light-exposed glass is baked at the furnace, and the baked glass is etched to form the spacer structure with groove patterns.

Alternatively, in addition to field emission displays, the above structure may be applied to other flat panel displays such as flat cathode ray tubes.

As described above, in the inventive flat panel display, a plurality of spacers are easily positioned at the non-display area through a single position controlling step so that the production efficiency can be significantly enhanced.

While the present invention has been described in detail with reference to the preferred embodiments, those skilled in the art will appreciate that various modifications and substitutions can be made thereto without departing from the spirit and scope of the present invention as set forth in the appended claims.

VERSION WITH MARKINGS TO SHOW CHANGES MADE

(Underlining indicates insertions. Brackets indicate deletions)

In the Specification:

The specification is amended as indicated in the following:

FLAT PANEL DISPLAY

BACKGROUND OF THE INVENTION

(a) Field of the Invention

The present invention relates to a flat panel display and, more particularly, to a flat panel display which has spacers for maintaining the cell gap in a constant manner.

(b) Description of the Related Art

Generally, flat panel displays (FPDs) have a faceplate, a backplate, and a side wall that are combined together to form a vacuum tight cell. The vacuum degree of the cell is established to be about 10^{-7} torr.

In such a flat panel display, compared to other display devices, it is difficult to constantly maintain the cell gap due to the difference between the internal pressure and the external atmospheric pressure. For this reason, one or more spacers are provided within the cell to maintain the cell gap in a constant manner.

U. S. Patent No. 5,650,690 or 5,543,683 discloses a method of fabricating a field emission display that has a gripper disposed on the faceplate, a Iocator disposed on the backplate, and a spacer wall interposed between the gripper and the Iocator. The spacer wall for securing the internal space of the device is formed with ceramic or

glass, and interposed between the faceplate and the backplate via the gripper and the Iocator.

However, in the above structure, the gripper and the Iocator for holding the spacer wall should be separately provided, resulting in increased production cost and complicated processing steps (for example, photolithography for a photosensitive material).

Furthermore, in order to fit the spacer wall between the gripper and the Iocator, each spacer should be inserted into the gripper or the Iocator. This requires elaborate working conditions while making it difficult to maximize work efficiency.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a flat panel display which can mount spacers without separate fixation members.

It is another object of the present invention to provide a flat panel display which can be fabricated in a simplified manner.

These and other objects may be achieved by a flat panel display including a faceplate, and a backplate combined with the faceplate to form a vacuum tight cell. An image production unit is provided within the cell to produce display images from the cell. A plurality of spacers are mounted within the cell such that the [spaces] spacers are placed at a non-display area. The spacers are held between the faceplate and the backplate. A pair of alignment members are connected to the spacers in a body to align the spacers at the non-display area in a constant manner.

Each alignment member is connected to one-sided end portions of the spacers. A longitudinal axis of each spacer is preferably positioned substantially parallel to a side of the cell [The spacers are longitudinally placed along each one side of the plates parallel to each other].

A pair of subsidiary alignment members may be arranged perpendicular to the alignment members to form a rectangular frame.

Each spacer is provided with a plurality of exhaust grooves. The exhaust grooves are arranged at the spacer in the longitudinal direction while being spaced apart from each other with a predetermined distance.

Each spacer may be further provided with a plurality of grooves for preventing image distortion. The image distortion preventing grooves are arranged at the spacer in the longitudinal direction while being spaced apart from each other with a predetermined distance.

BRIEF DESCRIPTION OF THE DRAWINGS

A more complete appreciation of the invention, and many of the attendant advantages thereof, will be readily apparent as the same becomes better understood by reference to the following detailed description when considered in conjunction with the accompanying drawings in which like reference symbols indicate the same or the similar components, wherein:

Fig. 1 is a cross sectional view of a flat panel display according to a preferred embodiment of the present invention;

Fig. 2 is a perspective view of a spacer structure for the flat panel display shown in Fig. 1; and

Fig. 3 is a perspective view of a spacer structure fixed to a plate for the flat panel display shown in Fig. 1.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Preferred embodiments of this invention will be explained with reference to the accompanying drawings.

Fig. 1 is a cross sectional view of a flat panel display according to a preferred embodiment of the present invention where a field emission display (FED) is exemplified as the flat panel display.

The field emission display includes a faceplate 1, and a backplate 3 spaced apart from the faceplate 1 by [with] a predetermined distance and positioned [while proceeding] parallel thereto. The faceplate 1 is combined with the backplate 3 to thereby form a vacuum tight cell.

The faceplate 1 is sequentially overlaid with an anode electrode 1a, and a plurality of phosphor layers 1b placed at an even plane in [with] a predetermined pattern. A black matrix 1c surrounds the phosphorous layers 1b to improve contrast, the black matrix 1c being [and] formed with chrome (Cr) or chrome/chrome oxide layer (Cr/CrO_x).

The backplate 3 is overlaid with a plurality of cathode electrodes 3a placed at an even plane in [with] a stripe pattern while facing the anode electrode 1a. A plurality of gate electrodes 3c crosses the cathode electrodes 3a by interposing an insulating layer 3b. The gate electrodes 3c are also formed in [with] a stripe pattern.

The insulating layer 3b has breakthrough holes 30b at the positions where the cathode electrodes 3a and the gate electrodes 3c cross each other, and the gate electrodes 3c has also opening portions 30c at those positions. A microtip-based field emitter 3d is placed on the cathode electrode 3a within the area of each breakthrough hole 30b.

A plurality of spacers 5 are held between the faceplate 1 and the backplate 3. The spacers 5 are positioned at the non-display area in the cell where light is intercepted by the black matrix 1c.

As shown in Fig. 2, the spacers 5 are positioned parallel to [proceed along] the short sides of the plates 1 and 3 [parallel to each other]. Of course, the spacers 5 may alternatively be positioned parallel to [proceed along] the long sides of the plates 1 and 3. A pair of alignment members 7 are integrally provided each at one-sided end portions of the spacers 5 to hold the spacers 5 at the non-display area in a constant manner.

Subsidiary alignment members 9 are integrally provided each at one-sided end portions of the alignment members 7 to further reinforce the holding state of the spacers 5.

That is, the alignment members 7 and the subsidiary alignment members 9 altogether form a rectangular frame, and this frame can serve to maintain the spacers 5 at proper places in a constant manner.

In the field emission display having the above spacer structure, after field emission components are provided between the plates 1 and 3, the plates 1 and 3 are sealed together to form a vacuum tight cell. The vacuum degree of the cell is controlled to be about 10^{-7} torr through exhaustion.

However, in case the exhaustion process is performed in such a state that the spacers 5, the alignment members 7 and the subsidiary alignment members 9 are mounted between the plates 1 and 3 in the longitudinal direction, it is difficult to expect fluent exhaustion due to the spacer components 5, 7 and 9.

Therefore, in this preferred embodiment, a plurality of exhaust grooves 5a are formed at each spacer 5 to realize fluent flowing of exhaust gas within the cell. The exhaust grooves 5a are arranged at the spacer 5 in the longitudinal direction and are positioned adjacent to [while standing with] the backplate 3. The exhaust grooves 5a are spaced apart from each other by [with] a predetermined distance.

Furthermore, a plurality of image distortion preventing grooves 5b are formed at each spacer 5 and are positioned adjacent to [while standing with] the faceplate 1. The image distortion preventing grooves 5b are to reduce the contact area between the spacer 5 and the faceplate 1, thereby minimizing distortion of picture images due to the contact resistance. The image distortion preventing grooves 5b are spaced apart from each other by [with] a predetermined distance in one to one correspondence with the exhaust grooves 5a.

Exhaust grooves 7a and 9a are arranged along the [The] alignment members 7 and the subsidiary alignment members 9, the grooves 7a and

9a being symmetrically positioned adjacent to, respectively, the faceplate 1 and the backplate 3 [are also provided with exhaust grooves 7a and 9a that are arranged in the longitudinal direction symmetrical to each other at both sides thereof]. The exhaust grooves 7a or 9a are spaced apart from each other by [with] a predetermined distance.

As shown in Fig. 3, in the fabrication process, the spacers 5 are mounted on the backplate 3 while being held by the alignment members 7 and the subsidiary alignment members 9. At this time, the position control of the spacers 5 can be easily performed once for all spacers 5 due to the presence of the frame structure, and, after the mounting, [the] stable positioning thereof can be obtained.

In accordance with the present embodiment of the invention [meantime], the spacers 5, the alignment members 7 and the subsidiary alignment members 9 are formed with a photosensitive glass. The photosensitive glass is exposed to light through an appropriately patterned mask, the light-exposed glass is baked at the furnace, and the [backed] baked glass is etched to form the spacer structure with groove patterns.

Alternatively, in addition to field emission displays, the above structure may be applied to other flat panel displays such as flat cathode ray tubes.

As described above, in the inventive flat panel display, a plurality of spacers are easily positioned at the non-display area through a single [one] position controlling step so that the production efficiency can be significantly enhanced.

While the present invention has been described in detail with reference to the preferred embodiments, those skilled in the art will appreciate that various modifications and substitutions can be made thereto without departing from the spirit and scope of the present invention as set forth in the appended claims.